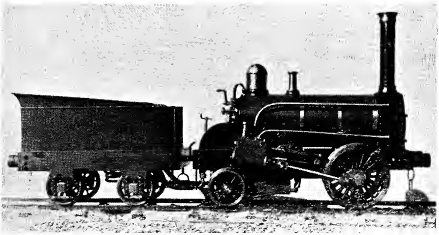
Simple Machine Tools for Production

THE MODEL ENGINEER

Vol. 87 No. 2156 • THURS., SEPT. 3, 1942 • 6d.

In this issue



THE RESULT OF AN AIR RAID!

Mr. N. Clarkson's workshop was almost destroyed in a "blitz." "L.B.S.C's." instructions on building a "Rocket" type old-timer made him decide to repair the workshop, and build the locomotive shown above. Further photos and full story on page 229.

THE MODEL ENGINEER

Vol. 87 No. 2156

Percival Marshall & Co., Limited
Cordwallis Works, Maidenhead

September 3rd, 1942

Smoke Rings

The Chronometer Fund

I AM pleased to hear from Mr. A. J. R. Lamb that his energies in collecting funds for the provision of chronometers for H.M. ships have resulted in a sum of close on £600 being realised. The majority of the contributions were the result of a personal appeal by Mr. Lamb, who is a Liveryman of the Clockmakers' Company, and I extend my congratulations to him on this commendable campaign.

Encouraging the Creative Interest

IN a recent letter Mr. L. R. Fooks makes the following comments on stimulating the love of good craftsmanship among those munition workers who are taking up mechanical work for the first time. He writes :—"Much has been written upon the subject of craftsmanship, and it is impossible to express an opinion in a few sentences on the subject of ways and means of stimulating craftsmanship, but it is interesting to consider how the vital interest could be fostered in the minds of the potential craftsmen now in the ranks of the vast army of newcomers to the munitions industry. I think it is reasonable to assume that through lack of earlier opportunity many are now obtaining their first acquaintance with machine and production tools, and instruction in their use. To the great majority of these newcomers their task will be a job of work carried out to the best of their ability and in the spirit of people working for a cause, but to a few this first experience may well be the means of arousing an interest, something more than a passing curiosity in the machine or tool, a creative interest which is the essence of craftsmanship. How then to detect and encourage this individuality? " I think the answer to this question is that in present circumstances the individual must be left to develop his new-found interest in his own way. This can be done by a wider reading of engineering literature, including THE MODEL ENGINEER, by joining a local model engineering society if such exists within his reach, or, if his time and energies permit, by embarking on some original constructive efforts in a workshop at home. In peace time, with greater spare time opportunities, something can be done by works welfare committees in staging exhibitions of model making or other handicraft hobbies, and in forming internal hobby clubs among the workers which may stimulate interest in model engineering or some other form of craftsmanship or applied science. There is no doubt that munition making, as a new experience, will release many latent human reservoirs of mechanical interest and ability.

A Surrey Model Yacht Club

MODEL yachtsmen on the southern side of London are to have their interests fostered by a new body formed under the title of the Surrey Model Yacht Club. The sailing water to be used is the One Island Pond on Mitcham Common, and for the time being members are meeting there to sail their boats on Sunday mornings. The club is limited to sail and has no power boat section. Further information may be obtained from the Acting Secretary, Mr. J. C. Monnard, 16, Hill Road, Mitcham, Surrey.

Ship Modellers Wanted

I HEAR from a firm in a West Scotland centre that they are in need of one or two men for the making of hulls of waterline ship models for the Government. The models are to the scales of 50 ft. and 100 ft. to the inch, and it is desirable that applicants should have had experience in this class of work. Permanent posts are offered, with good wages and working conditions. Travelling expenses would be paid to suitable applicants. I shall be pleased to forward any replies from readers who are interested, if addressed to me in the first instance.

Percival Marshall

Simple Machine Tools for Production

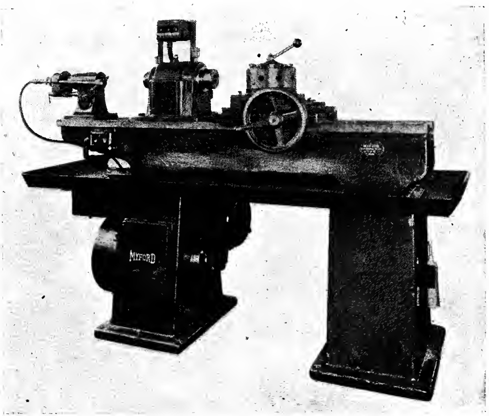
A review of some interesting special-purpose machines which are helping to solve production problems in armaments factories

By "NED"

MODERN industry is becoming more and more exacting in its demands on production machinery, as improvement of the products, whether their ultimate purpose is for use in war or peace, must necessarily involve greater complexity and also closer limits of accuracy. The latter quality can only be obtained by more meticulous accuracy of machine tools, which, even though it is not always an easy course to follow, is at least a straightforward one. But the increasing complexity of machining operations on components imposes a host of new problems on the machine tool designer, and often calls for complete reorganisation of production plant and systems.

Omitting, for the present, any consideration of the special problems which accompany machining operations of an unusual order, the mere *number* of operations on single components is much greater than it was a few years ago, but so far from tolerating the natural slowing-down of output which this entails, the tempo of production must be ever faster, as the demand for manufactured products rises.

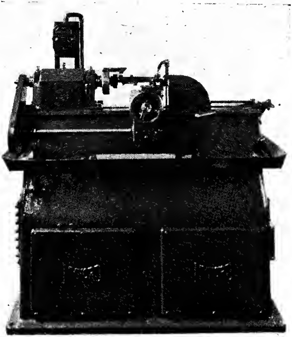
Under these conditions, the design of machine tools must be always improving and developing, and while there are few possibilities in the way of entirely new processes and methods, the ability of the tools to cope with a greater number of operations, in some



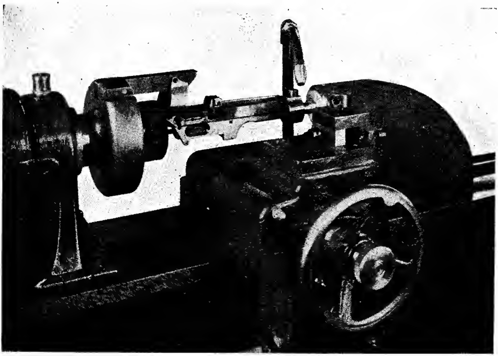
Special lathe for chambering the breech ends of rifle barrels.

cases simultaneously, has been exploited very extensively.

There are, broadly speaking, two distinct roads to the solution of the problem of rapid output on complex machined parts; the first, and perhaps the more obvious, is by elaborating the design of machine tools themselves by the provision of extra motions and operating tools, so that they can be adapted to cope with the multiplicity of operations. As an example of modern tendencies in this direction may be quoted the multi-spindle automatic lathe, which is capable of carrying out as many as a dozen highly accurate operations on a single piece, and machining up to six pieces simultaneously. The second method is by increasing the number of machine tools, equipping each one to carry out one, or at most two or three, operations in the simplest and most direct manner possible, the work being, of course, trans-



Rifle body-facing lathe.

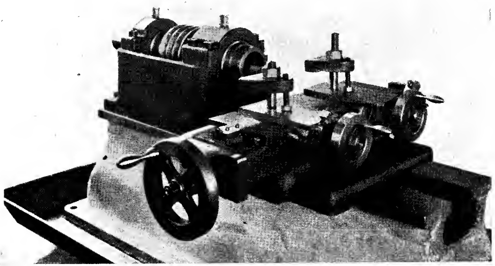


Close-up of facing lathe, showing work mounted on special arbor.

ferred from one machine to the next in rotation as the work progresses.

Both methods have their own advantages and limitations, but they fulfil well-defined places in production schemes, and both methods may be seen in operation in a single production line. The highly elaborate machine has the advantage of reducing the handling of work to a minimum, and also the risk of machining operations not being properly co-ordinated; but it calls for elaborate setting, which may absorb a good deal of time before production actually begins, and it is also most expensive to produce and install. On the other hand, the simple special-purpose machine is cheaply produced and installed, and quickly set up for a run of work; but it involves a good deal of handling of the work between operations, and also the problem of re-chucking or locating the work-piece for the engineers are familiar; the only "specialised" equipment called for in this instance being a chucking fixture to suit the component, and possibly the addition of limit stops to the tool slides, or special tool holders or adaptors. It may be news to some readers that lathes of almost identical type to those used in their own workshops are in regular service in factories engaged on the manufacture of accurate and up-to-date products.

The type of machine tool with which this article is principally concerned, however, is that which is designed specially, or at least primarily, to deal with some specific machining operation, and usually one of such a nature that it would present a serious problem if undertaken in an ordinary machine tool This does not necessarily mean that the operation, in itself, is difficult or complex; more often, it is because of some peculiarity of the component, by reason of which special



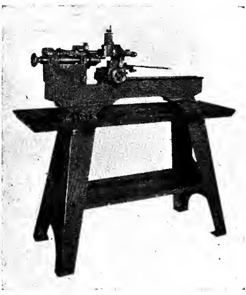
Second-operation lathe for work on rifle bolt and safety catch.

various operations in such a way that they are accurately co-related. Generally, the special-purpose machine is most useful in what may be termed "mixed" operations; that is, components which have to be produced partly by one class of machine tool and partly by another. As an instance, a component may be machined on its main surfaces by one or more operations in a milling or shaping machine, but may also call for certain portions being turned, bored or screwed. Such components are extremely common in the production of weapons such as rifles, machine guns and light ordnance.

In these cases, efficient work can often be done by simple, light lathes of a type very similar to those with which model problems of locating or chucking the part for a certain operation are introduced.

Chambering Machine

Take, for instance, the case of the special machine illustrated herewith, which has been designed for the purpose of "chambering" the breech end of rifle barrels; that is, boring and forming the cavity for the reception of the cartridge case. This involves the necessity for several tooling operations, and thus the tool slide is equipped with a turret-head; having nine stations. As it is necessary to insert the rifle barrel through the hollow mandrel of the headstock for the machining operation, means are provided for moving the turret-head cross-



Lathe fitted with chasing head for a special screwing operation.

wise on its slide, clear of the mandrel axis. This is preferable to sliding the entire tool slide endwise on the bed, as it avoids the need for disturbing the location of the latter, or operating clamping bolts.

The cross slide carrying the turret is located in its central position by a plunger or dowel inserted in steel bushes in the respective members of the slide; when this is removed, the slide may be pushed over by hand. When returned to the working position, the re-insertion of the plunger, which is chamfered at the end to provide a "lead," locates the turret-head in the true central position.

The headstock mandrel is, of course, bored right through, and fitted with a coned sleeve forming a chuck to receive the rifle barrel, the muzzle end of which is supported by a revolving bush steady, carried in a bracket at the left-hand end of the lathe bed. This bracket also carries an ejector for releasing the barrel from the coned sleeve when the operation is completed.

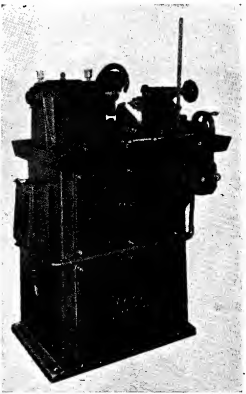
Only two mandrel speeds are necessary for the work handled by this machine; these are provided by a two-speed motor mounted on the rear of the cabinet pedestal, and driving a countershaft built into same, by twin vee belts. From the latter, the drive is taken to the mandrel by triple vee belts.

Coolant is forced through the barrel of the gun, by way of a gland fitting on the outer bracket, from an electrically-driven suds pump mounted on the back of the chip tray.

Facing Lathe

This machine is intended solely for the facing operation on the rifle body to form a seating for the attachment of the barrel. The component in this case is of a very awkward shape for chucking, and must be located in such a way that, with the tool in a fixed longitudinal position, facing is carried out to a fixed dimension in relation to essential surfaces machined in a previous operation. This purpose is effected by the special fixture shown, incorporating a work arbor and a driving latch, also an adjustable end-stop screw. The outer end of the arbor is supported in a bronze bush carried in the tailstock bracket. In order to allow of loading and unloading the component, the tailstock is provided with a withdrawal lever gear, which shifts the entire bracket bodily for the required distance.

The drive for this machine is arranged in an essentially similar way to that of the one previously described, but the mandrel is, in this case, of more orthodox design, being of the opposed-cone type, running in phosphor-bronze bushes, with a ball thrust-race in front of the rear bearing.



Simple form of grinding machine, adaptable to the use of simple fixtures for special operations.

A power cross traverse is provided to the tool slide ; this is driven from the lathe mandrel by means of an enclosed roller chain and sprocket gear. The feed-shaft at the front of the lathe bed drives a worm and spur gearing enclosed in the apron, and operation of the cross-slide screw is through a friction clutch, controlled by a knurled nut in the centre of the handwheel.

Second-operation Lathe for Rifle Components

The term " second-operation lathe " is generally taken to imply a comparatively simple type of lathe intended specially for the finishing of components which have been partly formed in a more complex machine, as, for example, the reverse end facing of parts which have been turned and parted off in a capstan or automatic lathe. In this particular case, the components for which this machine is primarily designed are the bolt-head and safety-catch of a rifle. These parts call for very close limits of accuracy, and the machine in question is therefore designed on " precision lathe " lines, with a large-diameter mandrel running in split phosphor-bronze bearings, and a special form of slide rest, with micrometer index to cross slide, and two separate tool slides having independent longitudinal movement.

Chucking fixtures specially designed to accommodate the particular components are employed, and are equipped with coned adaptors which fit the internally-tapered mandrel nose. Latch-type end-stops are provided to limit the movement of the cross slide in both directions, and the tool slides, which are only required to have a small range of axial motion, are equipped with stop arms on the spindles of the feed screws.

Chasing-Lathe

An example of a simple lathe equipped with a chasing-head for carrying out a precision screwing operation is also shown. As most readers are aware, a chasing-head embodies, in a modified form, the principle of the old traversing mandrel lathe ; but instead of moving the mandrel endwise in its bearings, the chaser or point tool is traversed by means of a bar carrying a half-nut or " follower " which can be engaged with the " hob " or master screw carried on the mandrel.

The chaser-bar is in this case equipped with a radial arm, which carries a slide in which the tool is mounted, and has a handle at the end by which it is brought into operation. When the tool is swung down over the work, the follower (also radially mounted on the bar) is brought into engagement with the hob. The feed is controlled by limiting the downward movement of the arm. In order to guard against torsional spring of the chaser-bar, limit stops are provided at two points : one engaging a flat bar over the front of the headstock, and the other in the form of a roller which rests on a flat surface of the cross slide.

The entire chaser gear, when out of action, is swung back, so that no interference is caused to accessibility, or with the operation of other movements, which consist of a screw-operated cross slide and a lever-operated axial slide, both equipped with end stops.

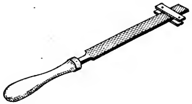
Form Grinding Machine

Several operations on rifle parts call for the accurate grinding of cylindrical, flat or contoured surfaces. The standard types of surface or form grinders are elaborate and expensive, and it is often possible to carry out the required operations by means of much simpler machines designed for a limited range of operations. In the grinding-machine illustrated, certain cylindrical, surface and form-grinding operations can be carried out by mounting the work-pieces in simple fixtures incorporating means of rotating or otherwise presenting them to the grinding wheel. Axial traversing is provided for by means of a slide operated by a hand-wheel at the end of the bed, and a diamond wheel dressing tool is mounted on the left-hand end of this slide, so as to be capable of being brought into action with the minimum expenditure of time and trouble.

[The above particulars and photographs are published by the courtesy of the manufacturers of the machines, the Myford Engineering Co. Ltd., Beeston, Notts.

A Clamp to Stop Bruising Fingers

If you, as many workers do, continually knock your fingers against the jaws of the vice when filing, here is a hint that will aid you.



Bolt a pair of blocks, just long enough to protect the fingers, near the end of the file, as shown in the sketch.

When the file is held, grasp the end past the blocks so that when the file is drawn back the blocks instead of the fingers hit the vice.—F. C.

A "Shaping Machine" Attachment for the Drummond 4-in. Round Bed Lathe

By G. A. GAULD

WITH the lathe as the only machine tool in the workshop, no milling device and no funds to spare for the purchase of expensive gear cutters of limited use, the attachment to be described was developed originally to produce a series of small gears for a special cinematograph camera. It was soon discovered, however, that the attachment had wider applications, converting the lathe, as it does, into a useful shaping machine.

is so simple, however, that a drawing is hardly necessary and the general layout should be clear from the details given in Figs. 1 and 2. The cutting stroke is applied to the saddle by means of a lever, a rate of about 100 cuts per minute being readily obtained.

The saddle must be freed first of all, by removing the lead-screw. To do this, the two set-screws which secure the handwheel bearing to the end casting are removed. The

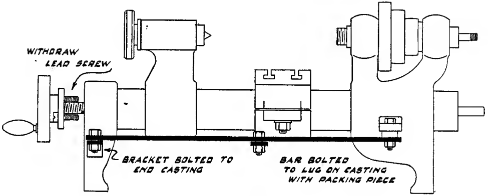


Fig. 1.

The obvious method was employed. The gear blanks were mounted in the chuck and a profiled cutting-tool set up in the normal tool holder. The cut was obtained by traversing the tool longitudinally, winding and unwinding the handwheel which operates the lead screw. This process was slow and extremely tedious, and the attachment was devised to simplify and speed up this part of the operation.

As a war job has taken the writer many miles from his home workshop, a scale drawing cannot be given. The attachment

handwheel and screw are then withdrawn a few inches, bringing the other end of the lead-screw clear of the headstock casting. By groping underneath with a pair of pliers through the V-slot along the bottom of the lathe bed, it will then be possible to extract the taper pin near the end of the screw. This pin normally engages the dogs of the change-wheel shift gear control and when it is removed, the lead-screw may be withdrawn completely by "unwinding" the handwheel. The saddle is thus free to slide along the lathe bed.

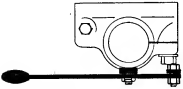


Fig. 2.

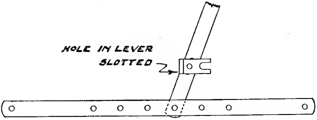


Fig. 3.

The attachment is made up of very few parts. A bar about $1\frac{1}{4}$ in. $\times$ $\frac{1}{4}$ in., drilled with $\frac{3}{8}$-in. holes, as indicated, is mounted at the back of the lathe. By removing the change-wheel engagement lever one end of the bar may be bolted through the lug in the headstock casting, using a suitable packing washer. The other end is bolted to a bracket which is in turn bolted to the end casting by a set-screw driven into a hole drilled and tapped in the casting itself.

The operating lever is made up from the same material. A bracket, detailed in Figs. 3 and 4, is made. The open slotted end slips under the nut on the saddle locking-bolt. The other end is bent up so that it presses against the body of the saddle, and thus transmits the pressure of the cutting stroke. The pivot pin is riveted in and the hole in the lever will have to be slotted to allow for the then turned up. This acts as an adjusting screw for the tool setting and by means of it, by slackening off the clamping screw, a feed may be imparted to the tool between each series of cuts.

To complete the tool holder, a bar is required to support it at the tailstock end. This can be made from a piece of mild-steel about 2 in. $\times$ $\frac{1}{2}$ in. It is drilled at one end with a centre bit and a slotted hole is provided for a length of $1\frac{1}{2}$ in. or so at the other. The holder is mounted by bolting one end through a slot in the faceplate and by setting the tailstock centre in the hole provided in the bracket at the other end. A rough setting is obtained by means of the slotted holes in both the bracket and faceplate. The tool holder should always be set as closely as possible to the work so as to reduce the "overhang" of the tool to a minimum.

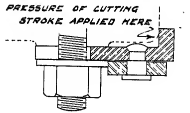


Fig. 4.

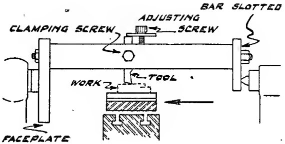


Fig. 5.

angular movement. The rear end of the lever is pivoted about a $\frac{3}{8}$-in. bolt set in one of the holes drilled through the bar at the back. The saddle may be located in any convenient position by choosing the most suitable hole.

A cutting stroke of some $2\frac{1}{2}$ in. to 3 in. is obtained. As the lever will have a reduction ratio of about 4 to 1, ample effort will be available combined with accurate control. Feed to the cutting tool is obtained in the usual way by means of the cross slide.

To make full use of the lathe as a shaping machine, another gadget is required to hold the tool. This is shown in Fig. 5.

A length of round mild-steel bar about $1\frac{3}{4}$ in. diameter is shouldered down at each end to $\frac{1}{2}$ in. diameter, the ends being screwed $\frac{1}{2}$ in. Whit. A $\frac{3}{8}$ in. or $\frac{1}{2}$ in. diameter hole is next drilled through the bar near the centre to take a cutting tool, made, preferably, from a length of round tool-steel. This is locked in place by a set-screw passing through a hole drilled and tapped at right-angles to the hole drilled first. Another hole is drilled parallel to the first at about $\frac{3}{4}$ in. centres and tapped with a fine thread, such as $\frac{1}{4}$ in. B.S.F. A screw with a disc head is

In certain cases, when the work is sufficiently small, the tool holder may be set up between centres. One end is held in the chuck and the other is centred on the tail-stock centre. In both cases the mandrel must be locked in position. To do this, a "pointer" may be mounted in the bracket which takes the first change-wheel spindle. It is made to engage firmly with a large change-wheel keyed to the mandrel, so preventing it from rotating.

The work is bolted to the slide rest and traversed across the tool by the ordinary cross slide feed. When each series of cuts is completed, the tool is reset by means of the adjusting screw, thus increasing the depth of cut until the work is completed.

The rear bar is left permanently in position, the headstock end being swung clear to allow of the insertion of the change-wheel engagment lever. The operating lever is readily removed, and the replacement of the lead screw is only a matter of minutes. The attachment, therefore, does not interfere with the normal usage of the lathe and its value will soon be appreciated when a job comes along which cannot be milled or turned up on the faceplate.

*Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the "M.E." small capstan attachment

By "NED"

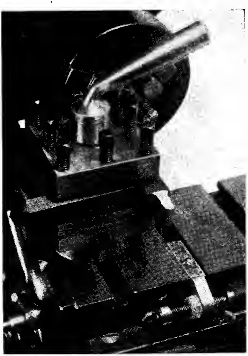
ANOTHER form of tool post which is extensively used on the cross slide of the lathe for production work is that which is equipped with means of bringing a number of tools successively into operation. There have been many forms of such tool posts developed, either for use on particular types of lathes or for universal fitting. Perhaps the commonest of all is the four-way rotating turret tool post, an example of which is shown in the photograph. This particular device was on the market previous to the war, and is understood to be still obtainable; it is intended for top slide fitting, but on the smaller sizes of lathes it is rather difficult to apply in this position because of the limited height available from the top surface of the slide to the level of the centres. For this reason, it would only be possible to use tools of small section, or specially made "dropped" tools. If, however, the turret is adapted to direct attachment to the cross slide, by the use of a suitable packing block and a tee bolt, it can be used to take much heavier section tools, and will also hold them much more rigidly than when used on the top slide.

The rotating turret is arranged to index in eight positions, at 45 degrees apart, and this enables each or any one of the four tools to be used for a double purpose, provided its shape is suitable. For instance a round-nosed tool could be set square-on to the lathe axis and used in this position for front roughing or grooving, and then turned 45 degrees to the left and used for end facing.

The tool stations are located by means of a peg or dowel in the stationary baseplate, which engages eight equidistant holes in the underside of the turret; in this way the tools are always brought to exactly the same position when indexed. To shift the turret it is necessary to unclamp the central hand lever nut sufficiently to allow it to be lifted clear of the peg. A spring is often fitted to lift the turret automatically when unclamped, but its advantage is somewhat questionable, as it makes it rather more difficult to find the position of the next hole when clamping down again.

Some forms of turret tool posts have other methods of indexing, such as a spring plunger or latch, working horizontally, and engaging holes or slots in the side of the turret. This constitutes an improvement over the method above described, as it is only necessary to slacken the clamping nut about a quarter of a turn to release the turret, and after the locking plunger has been withdrawn, it will find the next hole automatically. The few seconds saved in this way will make a great difference in the time taken in producing a large number of components. Another objection to the lifting of the turret is that it offers a possibility of swarf getting between the underside of the latter and the baseplate, thereby not only affecting the accuracy of the tool setting, but also entailing risk of damaging the appliance.

The multi-point tool post may be used either as auxiliary or ancillary to the employment of a rear tool post; but as the turret itself takes up more room on the cross slide than a plain tool post, the situation is liable to be even more crowded than usual when both are used together.



Four-way turret tool post set up on cross slide.

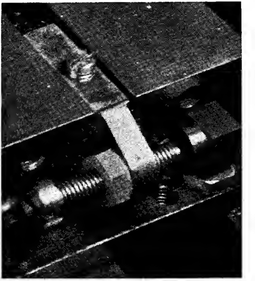
*Continued from page 185, "M.E.," Aug. 20, 1942.

It is thus advisable to dispense with the rear tool post, if possible, when the turret tool post is fitted. Many operators believe that there is some special merit in applying the parting tool from the rear, and in an inverted position; but this is not the case unless the cross slide is specially designed for the purpose, with provision for taking the upward thrust which is thus caused.

Although the general utility of the turret tool post in repetition work is beyond question, it should not be brought into operation unless the complication of the component renders it necessary. If it is possible to carry out all operations, with the exception of a simple forming operation and parting off, by the use of the capstan head tools, this course should always be adopted.

The reason for this is because of the comparative difficulty of arranging the cross slide turret tools to work automatically to a fixed limit, unless a complicated arrangement of end stops are provided on the cross slide. Often, too, longitudinal movement of the saddle may be called for, in order to use these tools effectively, and thus stops would have to be arranged to limit the saddle movement also. In large capstan and turret lathes, it is usual to provide an indexing stop bar to the saddle slide, so that traversing movement of each of the cross slide turret tools may be limited; but a single cross slide stop usually suffices, as the tools themselves can be set in the tool post or holder so that they complete their cut at the correct depth.

In the smaller and simpler capstan lathes, however, the advantages of being able to dispense with complexity in the manipulation of cross slide tools will be obvious, and it may be remarked that, in practice, very few of the components likely to be dealt with in these lathes involve the necessity for it. A very important part of the production planning department's job, in any engineering works, consists of simplifying small components so that complicated tooling of capstan lathes becomes unnecessary, and considerable time is thereby saved in production.



A close-up of the adjustable cross slide stop.

Other Cross Slide Equipment

The lack of room on the cross slide of a small lathe practically precludes the fitting of yet more gear on it, so that only a passing reference to the many additional items of cross slide equipment which are occasionally encountered should be necessary here. Steadies of various types are sometimes used for dealing with slender or unsuitable jobs, but unless they are ingeniously devised so as to be capable of being rapidly set and unmounted, they are liable to slow up production very considerably, or to impede the operation of other tools. Swinging work-stops, applicable in cases where all the capstan stations are fully occupied, have already been referred to; and knurling gear can also be brought into action by means of a swinging arm.

The use of chasing heads is uncommon on modern production lathes, but occasionally it happens that they are indispensable to some special production problem, and at least one example of this device applied to a small lathe has recently come to the writer's attention.

It is possible to apply extra tools in a vertical position, either above or below the work; the latter position is most common, as it enables the tool to be more rigidly mounted. The feed is applied tangentially, by the normal cross slide motion, and is very suitable for forming operations, especially if the tool is set obliquely, so that only a part of its width is employed at any given time. It is most important that the slide should be run back so that the tool is behind the work, before starting to machine each component.

A Simple Cross Slide Stop

Many requests have been received for advice on how to limit the travel of the cross slide for forming operations and similar purposes. Much, of course, depends on the type of slide rest fitted to a particular

lathe, and in some cases it is possible to attach a cross bar to the rear end of the slide way by clamping it over the latter or bolting to the end face, and simply fitting a stop screw to the cross bar. This course, however, is not so convenient in the case of the lathes possessed by most model engineers, in which the cross slide usually over-runs the slide way at the inner end of its travel and never allows much room for the fitting of a cross bar of this nature. It is equally inconvenient, and sometimes almost impossible, to fit a stop screw at the front of the cross slide, as the only practical location for it would be in the keep plate, and a screw projecting from the latter would almost inevitably foul the handle of the feed screw.

The appliance consists of two elements, one of which is attached to the cross slide and the other to the saddle. In the former case, it is designed to be anchored in one of the cross slide tee slots, being fixed in place by means of a single grub screw, so that it is not necessary to drill holes in the slide for its attachment. Previous to devising the tee slot fitting, however, the writer had used a holder for the stop screw which was screwed into one of two holes tapped in the side of the cross slide between the tee slots (these tapped holes can be seen in the photograph). The arrangement shown, however, is much handier, and more quickly applied. If desired, the grub screw which clamps the fitting in place may be sunk

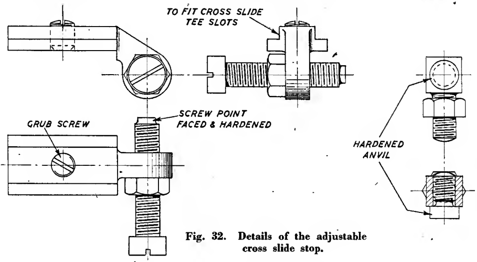


Fig. 32. Details of the adjustable cross slide stop.

flush with the surface of the tongue, so that there are no projections above the cross slide surface when it is in use.

The fitting was built up by pinning and brazing together two pieces of mild steel forming the tongue and the tapped lug, respectively, but it could have been machined from the solid fairly easily, or made from a casting. An ordinary machine screw, 1¼ in. long by ¼ in. B.S.F., was used for the stop screw, the end being very carefully faced dead flat and turned down below the core diameter of the thread, then case-hardened.

It is necessary to drill and tap one or more holes in the top surface of the saddle to accommodate the fixed stop, which is made from a piece of ⅜-in. × 5/16-in. rectangular steel bar, the end of which is turned down and screwed ¼ in. B.S.F. A cross hole is then drilled through the upper part and screwed ¼ in. × 40 t.p.i. to take the hardened anvil.

The exact dimensions of these components will, of course, depend on the lathe

Some readers have therefore reasoned that it is almost impossible to equip this form of cross slide with an end stop without a great deal of trouble, involving some restriction of its motion, and possibly encumbering the motion of other working parts. Considerable thought has been given to this problem, as a result of which the adjustable stop shown in Fig. 32, and also in the accompanying photograph, has been evolved, and has proved entirely satisfactory in the course of two or three months' practical test.

An interesting and useful feature of this stop is that it can be mounted on or detached from the cross slide in few seconds, and a when fitted, it is entirely out of the way, so that it does not restrict any of the slide movements or take up room which can ill be spared. It would be quite feasible to develop it into a double stop for limiting the feed motion in both directions, if this should be necessary; but the single-way stop is sufficient for most small capstan lathe operations.

to which they are fitted; there are differences of detail, even in lathes of a given make, according to their date of manufacture. It is necessary to position the tapped hole in the lug of the screw holder, and the hole or holes in the saddle for the reception of the fixed stop, in such a relation to each other that the stop screw abuts squarely in the centre of the anvil, when brought into contact with it by the motion of the slide. The tongue should be a close fit in the tee slot, so that it does not tend to slew round under pressure; but in order to contend with any slight shifting, the slide should always be fed hard up on the stop when first fitted, to eliminate the risk of adjustment being subsequently upset through this cause.

It is possible either to simplify or elaborate this device to suit individual taste, but in the form shown it will be found quite satisfactory for all practical purposes and reasonably accessible for adjustment. Some readers have asked for a *micrometer* end stop; this term is a somewhat indefinite one, but presumably is intended to mean one having a marked graduated screw reading in thousandths of an inch. The modification of the screw holder necessary to incorporate this refinement is a fairly straightforward matter, and the screw may be cut 40 t.p.i. and equipped with a graduated thimble if desired. Its success will depend mainly on the workmanship and material put into it; but it may be remarked that an ordinary micrometer screw is not really robust enough for the heavy duty and rough usage it is likely to get when applied in this way. The use of an ordinary lock nut is not advisable, as it may damage the very fine thread when repeatedly tightened.

In most cases, when micrometer stop screws are fitted on machine tools, they are made much larger than the standard ¼ in. × 40 screw, and special provision is necessary to protect them from wear, especially when they are likely to be buried in chips or swarf most of the time. Few capstan lathes are equipped with micrometer stops; in fact, the arrangements for adjusting the tools are sometimes very coarse and primitive, and there are many professional tool setters who would be very satisfied with a 26 t.p.i. adjusting screw as specified in the present case.

Automatic Collet Chucks

Some time ago, I mentioned that I was investigating the possibility of equipping small lathes with chucks of the "automatic" type, which can be operated without stopping the mandrel. Readers may be interested to learn that a successful chuck of this type, quite simple in construction and applicable to any lathe, has been evolved, and when sufficient evidence has been obtained, by practical test, of its satisfactory operation, it is hoped to furnish a description of this device. There is more than a bare possibility that the chuck, or a modified version of it, may be put into production by a well-known firm of lathe manufacturers, in which case it will be possible in due course, to obtain one ready-made.

Automatic chucks are almost universally fitted to production lathes designed for bar work, as they save a great deal of time between operations, especially when the lathes work at high speed. Hitherto, however, it has only been possible to fit them to lathes having the mandrel specially designed to incorporate the chuck mechanism as an integral feature.

It should be noted that, in order to use a chuck of this type effectively, it is also necessary to provide some means of feeding the bar forward when the chuck is released, but this is a relatively simple matter, and does not necessarily involve any elaboration of the lathe itself.

(To be continued)

Don'ts for the Model Engineering Beginner

As one who is a constant and appreciative reader of THE MODEL ENGINEER, I think that there must be many in the elementary stage of model engineering who would derive some benefit from the following list of "Don'ts" which I have compiled from experience. It is surprising how often such simple matters are neglected.

Don't make hammer marks on your models.

Don't use the tail end of your vice for an anvil.

Don't screw bolts and nuts hard enough to strip their threads.

Don't use your vice more than a month without oiling it.

Don't try to drill a piece of metal unless it is properly supported.

Don't attempt to drill a hole unless you know that the drill is properly ground.

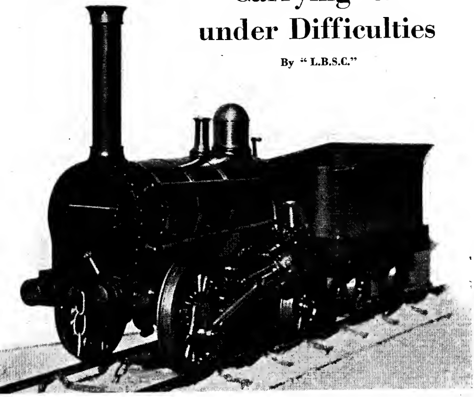
Don't drill or ream out holes in aluminium model parts (or its light alloys) without using a suitable lubricant; kerosene, or a mixture of equal parts of paraffin and lard oil, are about the best.

Don't tap a hole and put a screw or bolt in it without clearing out the chips.

Don't try to take a bruise or indentation from a flat surface with a scraper or the tip of a file.—A. J. T. EYLES.

Carrying on under Difficulties

By "L.B.S.C."



Mr. N. Clarkson's "Rainhill."

THE complaint that most readers of these notes suffer from—no, that's wrong; you can't call it "suffering." Suppose we say that the complaint which affects most readers of these notes, and the party who writes them, is incurable. Once anybody gets properly bitten by the locomotive germ, nothing can stop the whole doings taking its course; not even the antics of Adolf's womming-birds, as the following will show. Towards the end of 1940 Mr. N. Clarkson, of Liverpool, was building a tender for a Southern "S.15" 4-6-0 which he had made to your humble servant's specifications, and getting on fine with it. Along came Jeremiah, and in an episode which is typical of the perfection to which "civilisation" has been brought in these years of grace, the ceilings of our friend's house came down, and his workshop in the garden very nearly disappeared. Fortunately, his lathe and tools were not seriously damaged, and he managed to cover them up sufficiently to protect them from the weather whilst the house received first-aid.

Although our friend's workshop activities had been brought to a stand-still, he was still following the notes when I described how to build the old Rocket-type engine "Rainhill." This took his fancy, especially as he lived in one of the terminal cities which these engines served; and as the raids had eased off and better weather was on the way, he decided to patch up his workshop and have a go at building one of the old-timers. After a lot of looking around for material, he managed to get hold of a few pieces of 4 in. by 3 in. timber for supports, and fixed up the workshop to an extent that was fairly leakproof, although rather draughty when the wind was blowing. Anyway, he managed to work in the shop all right, and the result was what you see in the pictures reproduced here. The engine has not been fully tried out yet, but on a short temporary track he says she steams like a witch and has plenty of power.

Mr. Clarkson has a friend who owns a suitable track, and hopes to try out the engine on it at an early date; but the trouble so far is that his friend's day off and his own have not fallen on the same

day. Mr. Clarkson has a son living at Runcorn who, when he saw "Rainhill," promptly announced his intention of building a sister old-timer, so he has made a start on a 3½-in. gauge 2-2-2 "Jenny Lind" of 1847. This engine will also be built to my specification. Clarkson Junior has already turned the crank axle with four eccentrics, out of a piece of 2½-in. diameter shafting. Nothing like kicking off with a good hefty job!

As regards the Southern "S.15," she is a fine sturdy machine, as can be seen from the picture, and our friend has restarted work on the tender, which he hopes now to complete at an early date, saying that the work helps him to weather these stormy times. I guess we all find it the same; personally, if I can't spend the twilight of life in peace, I don't want to spend it in the loonies' home, and the locomotives have kept me on the right side of the doorstep! Incidentally, the "S.15" engine would make a fine job in 3½-in. gauge. A full set of blueprints for her, made from my original drawings of the 2½-in. gauge engine, are available, and could be used to build the larger one, as mentioned last week; but will new readers and others interested, please note that I neither make nor sell blueprints, although I can tell you where to get them if you send me a stamped self-addressed postcard. Hearty congratulations to Mr. Clarkson for his fine example of how to "stick it" under difficulties, and for his fine work.

Heavy Traffic on the "Polar Route"

Ever since my non-stop line was opened for traffic in 1936 I have been trying to find time to instal automatic signalling, so that we could run more than one engine at a time under proper "railway" conditions. But there are only 24 hours in a day, and I am only a human being and pretty well worn at that; so the signals have so far not eventuated, and if more than one engine has been in steam at the time, drivers had to run on what our cousins over the pond call "smoke orders."

On a recent fine Saturday evening, for the first time we had three engines going at once. Mr. Dick Simmonds brought his 3½-in. gauge "Dairymaid" and his daughter Doris, and Messrs. George Court and Fred Stone brought two of the ever-popular "Maisies." The last-mentioned was the first in steam, and she started off around the line with three cars and a passenger on each, running without effort with the lever next to middle, and keeping on the sizzle. Then George Court got up steam, and train No. 2 started operations. Finally we lighted up the "Dairymaid," and with Doris Simmonds at the regulator, she joined the "circus," and the three of them, like the beacon fires in Macaulay's poem, went "on and on without a pause, untired," until close to blackout time. Fred Stone's "Maisie" covered nearly four miles, George Court's about three, and the "Dairymaid" two. Doris Simmonds is a skilful and very careful driver. She reminded me very strangely of Curly in the 'nineties, especially after the driver's wife had finished with me on the night I was three-parts drowned in the storm; loves engines, and is very fond of driving one.

Good folk who fondly imagine they have a first-class engine when it will go about 300 ft. or so on one firing, should have seen George's "Maisie." It just refused to "die out" when it was time to shut down, and "kept on keeping on" until it had run about three-quarters of a mile after the final shovelful had been put on. Even then, there was still some fire in the box and 25 lb. or so on the "clock." Others who might have had a severe shock, were those who believe in small-bore cylinders, and deny that a little engine can be run on expansion working.

Both the "Maisies" were made according to "words and music," and had cylinders 1¼-in. bore with proper valve gear and timing; consequently, both of them ran with the levers close to middle, only needing a whiff of steam to keep them going at a good speed, very soft blast, and very little coal and water needed. The only mishap was one derailment. The lubricator ratchet lever of friend Court's engine got damaged on the way over, she slid sideways in the car, and the bogie wheel caught it; but with a good dope of oil to start, and a few turns of the lubricator by hand whilst she was on the road, kept enough oil in cylinders and steam chests to enable the engine to run without any harm coming to them. Drivers and firemen on passing S.R. goods trains, and passengers on the "Milly Amps," were apparently much interested to see the three locomotives sailing merrily around, one with a girl driver.

By the time we had got the engines off the road, it was time to put up shutters, so we adjourned to my workshop, and as the enginemen's best friend was "in short supply," we made coffee do instead, and we talked locomotives until the hands of the clock had reached 12.10 a.m., when the gang "swiftly and silently faded away, by the light of the silvery moon" as some poet described it, only he forgot to add "per gasoline cart." It was a welcome "break" from war worries; Mr. Simmonds runs a fleet of contract lorries, and Messrs. Court and Stone are armament makers, although

they both infinitely prefer building locomotives to bring pleasure and happiness into life than the wherewithal to terminate it and destroy what others have built. Ah well! I only hope and trust that the boys and girls now growing up will have more sense than their forebears, and devote all their energies to universal peace and happiness instead of allowing themselves to be led into an orgy of bloodshed and destruction.

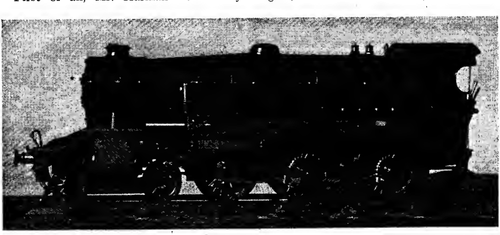
Sorry, Can't Oblige this Time!

I have received a good many letters from motorists who are followers of these notes, since the abolition of the "basic ration" (I *hate* those words as much as "model," "strategic," "economic," and "morale"), asking if I would give details and drawings of my suggested steam car engine and boiler. Well, what's left of poor Curly is always willing to oblige wherever possible, but at the present time it just isn't. Apart from the fact that it is against my principles to give an untried "design" and leave a crowd of unfortunate folk to find out all the pitfalls and snags in it (as has been done in the past with so-called "model" locomotives), I have not the time to scheme out all the details of the complete plant and make drawings of it. As I mentioned once before, had I been twenty years or so younger, I would have accepted the offer of somebody "in the trade," to put my idea of a 2-2-0 road "live steamer" on the market; but it is too late now. However, certain comments in the above-mentioned correspondents' letters, and two experiences which recently came my way, will serve as an excuse for the following dissertation.

Steam on the Road

First of all, Mr. Harman Lewis duly brought his steam car around here and took me for a little run on it. It has a four-cylinder compound engine; an oil-fired flash boiler, with a burner which consumes any old kind of waste oil, and the exhaust is condensed in a "radiator" just like that of a gasoline cart, which is cooled by a fan driven by an exhaust turbine. What would be the clutch pedal on an I.C. car, notches up and reverses the engine; the brake pedal performs its usual duty, and the "accelerator" (literally!) is, of course, the steam throttle or regulator. On the dash are the usual "clocks" and gadgets. The switches and ammeter for the lighting equipment are identical with I.C., as is the speedometer; but in addition there is a steam pressure gauge (loud and prolonged cheers!), a steam temperature gauge, and a couple of small switches for burner and feed control. She is a big car, like a "Rolled Rice."

The car stood outside our hacienda about half-an-hour whilst Mr. Lewis took a looksee at my workshop and made the acquaintance of "Tugboat Annie" and some of her sisters. When we went out, there was 1,000 lb. or so on the "clock," and no sign of leakage anywhere. The car started off instantly on opening the throttle a shade, although the superheater had cooled off whilst standing, and until it warmed up again she was slightly sluggish, exactly like a locomotive on wet steam. However, as soon as the superheat rose above 600 degrees, she was as lively as a kitten. Mr. Lewis stopped her on the steepest part of Sanderstead Hill, so I could see how she restarted, which she did without the least trouble and hesitation. The even beats of the exhaust were music to one whose love for a steam locomotive is beyond all telling. The dead silence when stopping for traffic lights, and the absence of any whirr under



Southern "S.15," built by Mr. N. Clarkson.

the bonnet, either running or standing, would be a revelation to anybody who has always been used to the usual internal-combustion box of tricks. My "Morris Twelve" is a good car, but she would be far better with a direct-connected steam engine under the back seat and a boiler under the bonnet; especially if I fixed one of Jimmy Holden's oil burners on her, and did about 25 m.p.g. on the waste thrown away by our I.C. friends when they change the oil in their crankcases!

The Roundabout Way of Doing It

Secondly, I had a chance of examining a gas producer plant; and a more complicated outfit for a simple purpose it would be hard to imagine. The Tilling-Stevens petrol-electric system, now obsolete, always seemed to me to be unnecessary and a roundabout way of transmitting power, the vehicles being virtually electric cars carrying their own power station; what can be said of a gas-driven vehicle carrying its own gasworks? I don't know much about gasworks, my only personal contact with them being in my childhood days, when I was taken around the South Metropolitan Gas Company's plant in Old Kent Road by some kind person who said the fumes of a gasworks was a fine cure for children's coughs, as it killed all the germs. Whether it cured my cough or not, I don't exactly remember; but I do know that Mother said my curls smelt of "sulphur" for about a fortnight afterwards. Anyway, this conglomeration of blobs and gadgets on the back of the unfortunate automobile was a gasworks in miniature, from the firebox which answered as a retort, down to the scrubbing and filtering apparatus. In addition, there was an electric blower to keep the fire alight when the engine wasn't working, just as the blower on a steam locomotive is used when she isn't puffing.

The controls were a reminder of the cab of a big French compound or a New York Central "Hudson." In addition to the ordinary controls for working on petrol, there was another throttle for gas, an extra air valve, a separate ignition control, switches for petrol pump and electric blower, and one or two other thingamies, about eight altogether, and also a vacuum gauge. I thought at first it was a steam gauge and was just going to cheer, when I found it wasn't.

Like Lighting Up a Little Locomotive

The *modus operandi* was explained to me, and to the best of my recollection it was as follows. After seeing you had enough coal and water aboard, the fire was lit just the same as we light up a little locomotive, using cotton waste or rag soaked in methylated spirit (cleaner than paraffin, said my M.O.I.) charcoal, and the electric blower. When the coal—anthracite—caught alight, you were ready to start, but not on gas—oh no! Petrol had to be used until the gas began to generate. I can't describe in detail *how* it began to generate, but it is made by drawing steam over the fire. Anyway, after going some miles you had to shut the petrol throttle and try the gas throttle. If the engine stopped, you could safely bet there wasn't enough gas. If it didn't, but spluttered and tried to do the job, then the extra air, ignition and so forth had to be adjusted until the mixture was O.K. and the engine firing evenly.

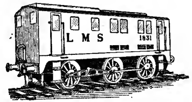
As all of us who operate locomotives know, an anthracite fire won't keep bright without any blast, and the suction of the engine provided the blast on the animated gasworks, only it had to be just so; not too intense, or the gas mixture was all messed up, and not too light, or else the blessed fire went out. That was the purpose of the vacuum gauge. If you went down a long hill with the gas throttle shut, or nearly so, the fire would go nearly out, if not quite, and then there was all the palaver of running on petrol again, and coaxing it up. I thought, migosh, *what* a jubilee driving this outfit, I wouldn't have time to look out for signals—I beg pardon, traffic lights.

Why Not Steam?

My reaction to the whole bag of tricks was, that it was the petrol-electric idea carried to an absurdity. There *was* some excuse for the latter, inasmuch as it did away with the gearbox and clutch, and provided an infinite range of speeds; the controls were simple in the extreme, being merely an engine throttle and a dynamo field regulator. But here, we have the whole complication of the ordinary petrol-driven car plus the extra complication of a travelling gasworks, and *all needless*; that is the irony of it. The finest petrol-driven car ever put on the road is "unmechanical" when compared with a steam locomotive. Its engine won't reverse and won't start itself, and it only gives its power at speeds above a certain minimum, hence the clutch and gearbox, electric starter, and all the rest of it. Why on earth *light a fire* and introduce all these extra complications just to retain the whole mechanism of the car as it stands and simply to avoid having to use imported liquid fuel?

The alternative? Well, Curly will tell you, STEAM (capitals, please Mr. Printer; it's worth it). If we have to light a fire, why not light it *in the proper place, viz., the firebox*

(Continued on page 236)



* EDGAR T. WESTBURY'S 1831

Cutting the Transmission Worm Gearing

I HASTEN to apologise for having "dropped a brick" over the drawing of the worm gear blank, as published in the last instalment of this article. The error was, however, an obvious one, though it was noticed too late to enable it to be corrected before going to press. It arose by reason of the fact that my experimental work in cutting the gears has been carried out with blanks of ⅜-in. bore, as a matter of convenience, to allow of the use of a single mandrel for machining both the worm wheel and pinion blanks. The discrepancy in the bore dimensions had slipped my memory until the matter of fitting the worm wheel to the jackshaft had to be considered.

As I mentioned some time ago, the methods which I have adopted for producing the gearing, while basically sound, are somewhat unorthodox, and the specification of the gears does not conform exactly with any standard formula. All that I claim for it is that it *works* fairly efficiently; and if any of the gear-cutting experts object to my having obtained the right results by wrong methods, I would remind them that when I first tackled the job I admitted my lack of specialised knowledge on the subject of cutting worm gearing, and asked for their co-operation. As this was not forthcoming, they can scarcely blame me if my methods outrage all respectable laws and conventions! Not that it is too late to correct matters—on the other hand, if they can furnish a gear specification which will enable a higher efficiency to be obtained, or a better method of producing the gears with simple equipment, I shall be pleased to adopt it in preference to my own.

It is quite possible that I am in grievous error even in respect of the terms I have used to describe these gears, as I have called them a "worm wheel and pinion," though it is more usual to refer to the driving member of the pair as a "worm." I have, however, a definite reason for adopting the term "pinion," as I have found in discussion with practical engineers that this conveys a better impression of a worm of this particular type, which is capable of being used either as the driving or driven member.

It will be seen that I have worked out the pitch dimensions of these gears to conform with fractional sizes, and on the drawing (Fig. 130) these are stated to four decimal places; but this does not imply that it is necessary to work to such fine limits in turning the blanks. As a matter of fact, I have found that slight errors in the actual dimensions do not seem to have a very pronounced effect on the working efficiency of the gears when finished.

Worm pinion being cut in lathe, showing method adopted for indexing blank to cut seven-start thread.

*Continued from page 181, "*M.E.*" *August* 20, 1942.

Worm Pinion

Material: Mild steel (finally case-hardened).
Pitch diameter: 11/16 in.
Number of teeth: 7.
Spiral "Lead" (or true pitch) 1¼ in.
Addendum 0.050 in.

The blank should first be bored and

reamered, then mounted on a mandrel for turning the outside, and cutting the teeth. As the latter operation will involve a fairly considerable torque stress, the work should fit the mandrel tightly, or, better still, the latter may be provided with a nut to enable the blank to be pulled up firmly to a shoulder. Provision should be made for cutting an extra worm pinion, and time may be saved if this is mounted on the mandrel and cut simultaneously with the first. The object of the second worm is to form a hob for finishing the worm wheel; it should for this purpose be made of tool steel, and afterwards hardened and tempered. It will, however, be found that the toughness of tool steel makes it very difficult to cut

As previously pointed out, the worm pinion is really a multi-start thread, and may be produced in the lathe by the aid of the screwcutting gear. One of the greatest difficulties, from the point of view of the model engineer with limited equipment, is that of obtaining the required gear ratio between the mandrel and the lead screw, as it is necessary to step the speed up instead of down, and in the case of a lathe having a lead screw of 8 t.p.i., the required lead of $1\frac{1}{4}$ in. requires a ratio of 10 to 1, which cannot be obtained with the standard set of change wheels usually supplied with small lathes.

When discussing this problem with Mr. Ian Bradley, who has assisted me in the

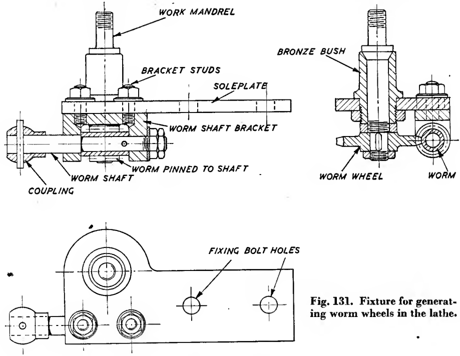


Fig. 131. Fixture for generating worm wheels in the lathe.

the teeth cleanly, and as an alternative a mild-steel hob, case-hardened, will perform the necessary duty fairly efficiently. It should be made longer than the actual worm pinion—about $\frac{1}{2}$ in. or $\frac{5}{8}$ in. will be sufficient if the teeth are cut for the full length. Some workers may prefer to make the pinion and the hob from one piece of steel held in the chuck, and to cut the teeth on them before parting off. This dispenses with the need for making a mandrel to mount them, but involves some extra difficulty in indexing the blank to cut the multi-start thread. In any case, a mandrel will eventually be necessary to carry the hob, when the hobbing of the worm wheel is undertaken.

experimental work involved in producing these gears, I found that he was in possession of two 100-tooth change wheels to fit his lathe, and this made it an easy matter to set up for the required ratio, by using a compound train, with the two 100 wheels as drivers, and 20 and 50 as driven wheels. Expressed in the usual formula, the train may be better understood thus:—

$$\frac{100 \times 100}{20 \times 50}$$

In actual fact the *role* of driving and driven wheels is reversed, as it is necessary to apply the power from the lead screw end. If the lathe is not normally equipped for traversing on the lead screw, it will be

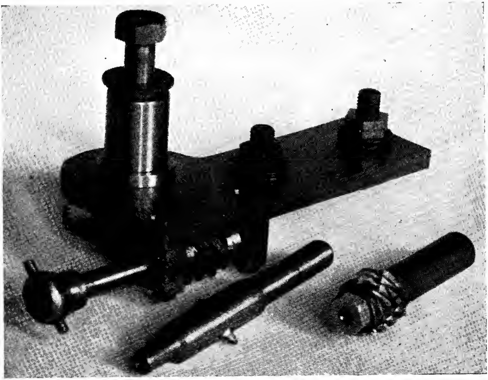
necessary to equip the latter with a hand crank, which should be of liberal size, and comfortable to handle, as a good deal of power has to be applied through it. The small balanced handle usually fitted on light lathes for this purpose may be found rather inadequate for the job, but it is not a difficult matter to remove it and fit a larger one temporarily.

When the train is set up, particular care should be taken to ensure proper meshing adjustment of the gears so that they work smoothly, and the studs on which they run should be very firmly tightened.

Indexing

When cutting a multi-start thread, the blank must be indexed for each individual thread, so that an even spacing around the circumference is obtained. Many turners do this by using a gear wheel on the mandrel, having a number of teeth divisible by the number of starts, and using this as an index by taking it out of mesh with the next wheel, and remeshing after altering its relation by the required number of teeth. This method, however, while satisfactory in skilled hands, is open to disastrous errors in certain circumstances, and moreover, the use of a 100-tooth wheel on the mandrel precludes its use in the present case, as this number is not a multiple of 7.

In my opinion, an easier and more fool-proof method of indexing is to arrange some device on the driving plate or work mandrel for this purpose, so that there is no need to interfere with the meshing of the change wheels. One way of doing this would be to divide out the circumference of the driving plate and provide holes (or other means of location) for the driving pin in the required number of positions. A method which is even simpler, and which I recommend in the present case, is to use the normal driving plate, with a single driving pin, but instead of using the usual carrier on the work mandrel, to mount a gear wheel on the latter, having a suitable number of teeth for the required purpose, and driving the latter through a latch or detent from the driving pin. In the present case, a 35-tooth wheel, which is to be found in nearly all standard sets of change wheels, will be found suitable ; it is, of course, shifted five teeth at a time to cut each individual thread. To avoid errors, the teeth of the wheel to be engaged should be counted out and marked, by chalking or otherwise, before commencing the operation.



Fixture employed for cutting worm wheel; also, cutter bar and hob for forming teeth.

Form of Tool

The tool used for cutting the thread is similar to that used for a standard "Acme" thread, but instead of the usual 29 deg. tooth angle I have found it better to employ a tool having an included angle of 40 deg. This may be open to criticism, and it is possible that it may lower the efficiency of the gears by increasing the force tending to wedge them apart; but I may mention that I was originally put up to it by Mr. J. Latta.

The width of the tool at the end face is 0.050 in., but as it may be difficult to measure this exactly it is better to make it a little too narrow than too wide, as the thickness of the tooth can be reduced by taking a side cut, or making it a little deeper than the drawing shows. There is no objection to extra depth of tooth, as this merely increases the clearance over the tops of the teeth of the worm wheel; incidentally, I may mention that the figures shown in Fig. 130 do not provide for any clearance here at all, which I must admit is an oversight on my part. The clearance usually allowed here is about 0.008 in. on the radius.

It is advisable to make the tool in round silver-steel, so that it can be set in a holder, and turned so as to conform with the angle of lead. The shape is most easily produced by filing before the tool is hardened. A small bevel gauge or engineer's protractor, set to the required angle of 40 deg., may be used for gauging. Clearance should be provided on both side faces, and also on the front; top rake in a moderate degree is helpful, but it cannot be used to the best advantage in a tool of this nature. After hardening, the edges should be carefully honed with an oilstone or carborundum slip; grinding is extremely difficult unless an angle jig or some other means of mechanically producing the correct form is available.

It is immaterial, from the purely utility point of view, whether the pinion is cut with a right-hand or left-hand lead (so long as the worm wheel is cut to correspond), but most workers will find a right-hand lead most convenient. As it happens, however, there would be some advantage, from the control point of view, in using a pinion with a left-hand lead. This matter affects only the direction in which the gear control lever must be moved in order to drive the locomotive forward or in reverse, as the transmission gear itself operates equally well, and gives the same gear ratios in either direction.

When cutting the teeth of the pinion by this method, the principal ingredient in the recipe for success is Patience—with a capital P. Anyone who is in a hurry will be almost certain to make a mess of things. It will be found inadvisable to take a cut deeper than about 2 thou., and less than this when the tooth approaches completion, so that each tooth will take at least 60 or 70 passes of the tool. Do not attempt to unclasp the lead screw nut at the end of the cut and "pick up" the thread again each time; it is just as easy, and far safer, to run the saddle back each time by reversing the rotation of the lead screw handle. The tool must be kept perfectly keen; if it becomes blunt, a rub with the oilstone slip while it is in position is indicated, as it may be difficult to remount it exactly in the proper location if it is taken out for grinding.

As an alternative to cutting the teeth in this way, readers who possess a good milling attachment may find it more efficient to mill them, using a cutter of similar shape to that specified for the single-point tool; the cutter spindle is set horizontally over the work to the angle required to present the cutter at the correct lead angle. The gear train and indexing arrangement as described above are retained, and are used in the same way as before.

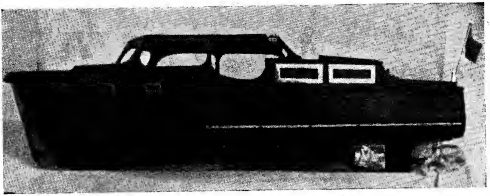
This method has the advantage that each tooth can be completely cut at one pass of the cutter (though in practice it will be advisable to take at least one roughing cut and one finishing cut), but it is only practicable if the rigidity of the milling fixture is beyond question, and it is geared so that adequate power can be applied to the cutter at a speed which is not excessive for efficient operation on steel.

(To be continued)

"L.B.S.C."

(Continued from page 232)

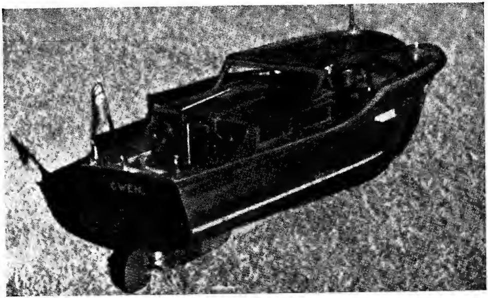
of a steam generator, not a wandering scent-factory. Use the steam in a simple two-cylinder engine geared direct to the differential, the whole enclosed and working in an oil bath like a locomotive booster. Away goes your clutch, gearbox, multitude of controls, electric starter, plug troubles, and every other evil in one fell swoop. The automatic stoker would feed the firebox of the boiler just the same as it would feed the gas producer, and the controls are reduced to a simple throttle and boiler feed regulator, whilst the power and acceleration would knock any gas-converted petrol car absolutely stony. I see by the papers that the Government are going to spend a vast sum in developing gas-producer plants. In the opinion of many good folk, including your humble servant, the money would be put to far better use in developing a simple steam car and two or three sizes of steam vans and lorries. What say you?



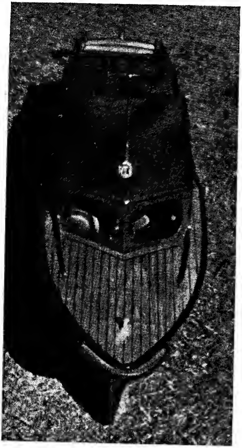
"Gwen"—a 30-in. Cabin Cruiser

(Scale 1 in. = 1 ft.)

THE wood used in the construction of this model was obtained mostly from old furniture, which was sawn up for a small sum at the local timber yard. A 2-in. thick plank of walnut was sawn up into strips $\frac{1}{4}$ in. wide for the ribs and $\frac{3}{8}$ in. wide for the keel. The ribs were built up and screwed so as to obviate any end-grain. The planks were sawn from a plank of mahogany $\frac{1}{8}$ in. thick. Plank fitting proved to be a very tedious operation, 0 × $\frac{1}{4}$ in. brass screws being used throughout. The decks are made from 3/16 in. chestnut, and the cabin sides, etc., from $\frac{1}{8}$-in. mahogany. A universal joint totally enclosed and running in an oil bath is built into the keel. The propeller shaft, which runs approximately parallel to the water line, is from 5/32-in. silver-steel running in bronze bearings in a 5/16-in. propeller tube. The main engine bearers are long enough to span 4 ribs so as to distribute the strain evenly to the hull. The power-unit is the famous Gwen-Aero $7\frac{1}{2}$ c.c. petrol engine. A $2\frac{1}{4}$-in. brass flywheel was fitted. The engine was first run in its original condition, but later converted to water-



Rear view, showing controls and sunken deck.



Deck view, showing imitation planking.

cooled. Trouble was first experienced in the water circulating system; but success was achieved with a simple scoop.

The boat was first run without a silencer, but owing to complaints from the park authorities, alterations had to be made. The roar of a small 2-stroke all out can be rather irritating to nearby residents who sleep on Sunday mornings. Eventually a simple expansion chamber was made and packed with steel wool; this certainly did lessen the "blitz" without much loss of power. The engine and steering controls are connected up to the wheels at the back of the rear cabin; the right works the advance and retard, connected up with flexible wires running in copper tubes; and the left is geared to the rudder by a screwed rod and a system of levers. A protractor and magnifying glass is let into the rear deck immediately above the rudder to facilitate accurate steering.

The cabin roofs were plank-built on walnut frames so as to make a bulged effect.

All the metal work is from brass. The knock-off ignition switch on the roof is filed up from the solid—no machine work has been used at all except parts for the universal joint and propeller boss. Chromium plating has been adopted throughout to resist corrosion from sea water.

Final touches include the additional fittings, lining of the decks and boxwood strips round portholes, door panels and rubbing strips.

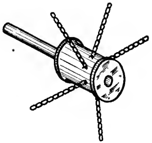
Several propellers have been tried. A 2-blader giving a higher speed but with considerable torque was abandoned in favour of a 2-in. diameter 3-bladed type.

The maximum speed is approximately 12 m.p.h., which gives a scale speed many times faster than the prototype.

The model was commenced in the summer of 1939, and was finished by the end of the year, thereby making it eligible in the Junior Section of any future "M.E." exhibition.—R. L. Walker.

Mottling Brass and Copper

THERE are many ways of mottling the surface of brass and copper, but I have found the best way is to obtain an odd length of steel chain (heavy watch chain size), about 7 or 8 links per inch will do. Cut this into lengths of 2 inches; to a cotton reel attach 5 pieces of chain with ordinary



staples, as per sketch. If this is revolved in the chuck at a fair speed and the work is allowed to come into contact with the ends of the flying chain, a very pleasing effect will be obtained. With a little practice a finish like morocco leather is the result.

When making a few petrol lighters for one or two of my pals in the Services I have found this to be an ideal finish for the main body tube. The mottling should be done before the assembly is sweated up.—E. A. Foster.

Letters

Suds Pumps for Small Lathes

DEAR SIR,—Perhaps some of your readers would be interested in the following. Having experienced some difficulty in providing our small centre lathes engaged on war work with a proper supply of suds, we have fitted the mechanical A.C. pumps from scrapped cars to our lathes in the following manner.

An eccentric is made with a throw of approximately 0.5 in. to fit over the end of the lathe mandrel (which generally projects about 1 in. or 2 in. beyond the rear bearing) : this is secured to the mandrel by a grub-screw, the head of which is sunk below the surface of the eccentric. The pump, which has an oval flange for 2-bolt fixing, is then secured to a suitable bracket which can easily be made from scrap and can generally be bolted on to the lathe by the two rear bearing bolts. The inlet side of the pump is then connected to the lathe drip tray with a length of copper pipe about ¼ in. or 5/16 in. O.D. A filter should be fitted at the tray end of the pipe. The outlet side of the pump is then connected by copper pipe to a suitable can of about one gallon capacity suspended at a convenient height above the lathe bed. An outlet from the can can be arranged with a length of old rubber air hose, a cock fitted to the end and a small support bracket arranged on the saddle to support the end of the pipe at the cutting tool. We have found these pumps extremely efficient, free from leaks, and their appearance has been frequently favourably commented upon by visitors.

Should you wish any further information, we shall be pleased to supply same.

Yours faithfully,
CAR CARE LTD.,
JOHN W. SMITH
Courthill, Bearsden, (Director).

Fly-cutters

DEAR SIR,—Mr. Doodson's adaptation of Mr. Westbury's fly-cutter described in your issue of August 6th, is interesting. I took advantage of the No. 2 M.T. socket on my 3½-in. Myford lathe and made the tool holder with a No. 2 M.T. shank. I tapped the tail end 5/16 in. Whitworth, fitted a rod long enough to go right through the mandrel, tapped the end of the rod and fitted a large brass nut from the junk box, this method reduces overhang to the absolute minimum. A most useful tool, and well worth the making—thanks, Mr. Westbury!

May I offer the following suggestion for your consideration; it has already been submitted to several reader friends and met with unanimous approval. It is that a series should be started, entitled "Looking Back," being reprints of suitably selected articles from the older numbers of THE MODEL ENGINEER.

I feel sure this would provide us with a very pleasant change from the locos. and petrol buzz-boxes which seem to predominate at present.

Yours faithfully,
"YORKIST."

Clubs

York City & District Society of Model Engineers

Next meeting Friday, September 4th, 7.30 p.m., at the "Bay Horse" Hotel, Monkgate. During the York "Holidays at Home" month, approximately 5,000 passengers were carried on the 3½-in. gauge track, 250 ft. long, which was erected in Rowntree Park. This meant about 100 miles, actual running. Two locos. were available, a 3½-in. gauge American type Pacific, made by Mr. F. J. Streets, and a North Eastern 4-4-0, by Mr. Jackson.

Hon. Sec., H. P. JACKSON, 26, Longfield Terrace, York.

The Society of Model and Experimental Engineers

The Workshop at 20, Nassau Street, London, W.1, is open on Tuesdays and Thursdays at 7 p.m., and on Saturdays at 5 p.m., and meetings will be resumed in September.

Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

The West Midlands Model Engineering Society (Wolverhampton Branch)

It was decided at the last meeting of the above Society to start again in earnest on Wednesday, September 23rd, at our headquarters, the "Red Lion" Hotel, Snow Hill.

Hon. Sec., F. J. WEDGE, 13, Holly Grove, Penn Fields, Wolverhampton.

Leeds Model Railway and Engineering Society

On Saturday, September 19th, Mr. W. D. Hollings will give a talk on Model Boiler Making; this meeting will commence at 2.45 p.m.

Meeting place, F. Cook, Kidacre Street, Leeds.

Hon. Sec., H. E. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Maidenhead, Berks.